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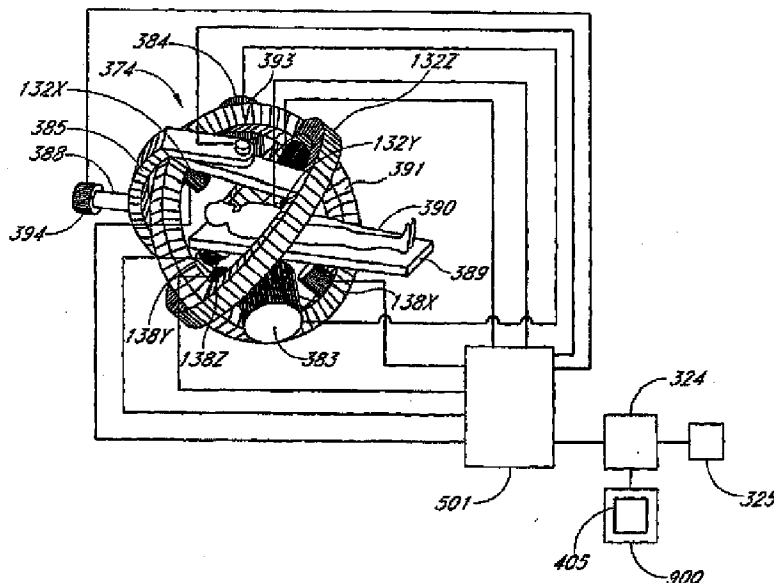
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[Continued on next page]

## (54) Title: RADAR-ASSISTED CATHETER GUIDANCE AND CONTROL



(57) Abstract: A Catheter Guidance Control and Imaging (CGCI) system whereby a magnetic tip attached to a surgical tool is detected, displayed and influenced positionally so as to allow diagnostic and therapeutic procedures to be performed is described. The tools that can be so equipped include catheters, guidewires, and secondary tools such as lasers and balloons. The magnetic tip performs two functions. First, it allows the position and orientation of the tip to be determined by using a radar system such as, for example, a radar range finder or radar imaging system. Incorporating the radar system allows the CGCI apparatus to detect accurately the position, orientation and rotation of the surgical tool embedded in a patient during surgery. In one embodiment, the image generated by the radar is displayed with the operating room

imagery equipment such as, for example, X-ray, Fluoroscopy, Ultrasound, MRI, CAT-Scan, PET-Scan, etc. In one embodiment, the image is synchronized with the aid of fiducial markers located by a 6-Degrees of Freedom (6-DOF) sensor. The CGCI apparatus combined with the radar and the 6-DOF sensor allows the tool tip to be pulled, pushed, turned, and forcefully held in the desired position by applying an appropriate magnetic field external to the patient's body. A virtual representation of the magnetic tip serves as an operator control. This control possesses a one-to-one positional relationship with the magnetic tip inside the patient's body. Additionally, this control provides tactile feedback to the operator's hands in the appropriate axis or axes if the magnetic tip encounters an obstacle. The output of this control combined with the magnetic tip position and orientation feedback allows a servo system to control the external magnetic field.

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2001/0021805 A1 (BLUME et al) 13 September 2001 (13.09.2001), Paragraphs 15, 34, 37, 42, 43 and Figure 1	1-34
Y	US 6,148,823 A (HASTINGS) 21 November 2000 (21.11.2000), Figures 1 and 5, column 4,	35-44
Y	US 5,775,322 A (SILVERSTEIN et al.) 7 July 1998 (07.07.1998), see column 5	1-44
Y	US 5,808,665 A (GREEN) 15 September 1998 (15.09.1998), see column 11, lines 12-20	18-19, 22, 24, 33

☒ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

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Y	US 6,381,485 A (HUNTER et al) 30 April 2002 (30.04.2002)	15, 23, 44
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